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EXAMINER

UMEZ ERONINI, LYNETTE T

ART UNIT

PAPER NUMBER

1765

DATE MAILED: 09/14/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/943,196

Applicant(s)

MAY, CHARLES E.

Examiner

Lynette T. Umez-Eronini

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 16 June 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 6-11, 13 and 21-26 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 6, 7, 8, 13, and 21-26 is/are rejected.
- 7) ☒ Claim(s) 9-11 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 30 August 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

This communication is in response to Applicant's Remarks in Amendment filed 6/16/2006, which was persuasive in showing the limitation of claims 6 and 21 were not addressed completely. Hence, a new Office Action is presented.

Claim Rejections – 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

3. Claim 13 is rejected under 35 U.S.C. 103(a) as being obvious over Koos et al. (US 5,934,980) in view of Merchant et al. (US 6,436,860).

Koos teaches a method of planarizing a substrate by employing two separate chemical mechanical polishing (CMP) steps (column 1, lines 5-9). In step 42 (FIG. 3), a first CMP polishing solution is applied to the surface of a polishing pad to facilitate planarization of the surface **35** of substrate **12** (column 5, lines 55-59), which is followed by applying a dilution solution to the polishing pad to remove slurry of the first CMP step, and after applying the diluting solution, a second CMP solution is applied to the polishing pad to facilitate additional planarization of the substrate (Abstract). In a preferred embodiment, the first CMP mixture includes an acidic pH with alumina particles (which is the same as applicant's aqueous slurry containing an abrasive material), (column 5, lines 55-65).

Koos teaches a second diluting solution that is applied to the polishing surface of polishing pad **16** for cleaning residual slurry (or the first CMP step) from the polishing surface of the polishing pad **16** (column 6, lines 1-5) and rotating wafer carrier **10** and the polishing table **18** continuously during the cleaning step, to enable removal of residual slurry from the substrate **12** and polishing head **27** at the same time (column 6, lines 8-10), which suggests the polishing slurry that is applied onto the polishing pad would also be disposed onto a semiconductor wafer. Koos also teaches a diluting solution is applied to the polishing surface of polishing pad **16** for clearing the residual slurry of a first CMP step (column 6, lines 1-5) as well as a second diluting solution, which comprises a solvent, such as, deionized or alternative solvents such as acetone or alcohol, (same as applicant's nonaqueous solvent), (column 8, lines 8-14). Hence, the aforementioned reads on,

A method of fabricating a semiconductor wafer, comprising:

(a) subjecting a front side of said semiconductor wafer to chemical mechanical polishing using an aqueous slurry; and

(b) disposing a volume of nonaqueous liquid including a non-aqueous solvent onto said front side of said semiconductor wafer during said chemical mechanical polishing. Since Koos uses the same method of polishing a semiconductor wafer by disposing an aqueous abrasive slurry onto the wafer with a polishing pad and disposing a dilution solution (same as applicants' nonaqueous liquid including a nonaqueous solvent) on a wafer for clearing residual slurry of the first CMP step from the surface of the polishing pad, then using Koos' polishing method in the same manner as claimed by applicants' would result in disposing a volume of nonaqueous liquid including a non-aqueous solvent onto said front side of said semiconductor wafer during said chemical mechanical polishing. to rinse the semiconductor wafer, **in claim 13**.

Koos differs in failing to teach said nonaqueous solvent includes an amine.

Merchant teaches, "The CMP slurry **10** includes a first emulsion **11** having a continuous aqueous phase (AQ_E) **12** and a second emulsion **13**. . . . The first emulsion **11** includes abrasive particles **18** . . . The second emulsion **13** preferably comprises an organic phase (ORG) **14** and a dispersed aqueous phase (AQ_I) **16** for capturing metal particles polished from the semiconductor wafer **20**" (column 3, lines 49-60). "The organic phase **14** may comprise alcohol or iso-alcohol and preferably includes at least one complexing agent such as, from example, . . . bi-pyridine (which is an example of a nonaqueous amine) . . ." (column 4, lines 12-19).

It would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Koos' polishing composition by including a nonaqueous solvent such as an amine that is taught by Merchant for the purpose of capturing metal particles polished from the semiconductor wafer (Merchant, column 3, lines 56-60).

4. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Koos (US '980) in view of Merchant (US'830 B1) as applied to claim 13 above.

Koos in view of Merchant differ in failing to explicitly teach said weight % of said nonaqueous solvent in said aqueous slurry /nonaqueous solvent mixture is increased until said aqueous slurry/nonaqueous solvent mixture is substantially free of said aqueous slurry.

The combination of Koos and Merchant illustrates diluting an aqueous slurry with a nonaqueous solvent is known.

Hence, it would have been obvious to one having ordinary skill in the art at the time the invention was made to employ the method of Koss and Merchant in diluting an aqueous slurry, which would thereby result wherein said weight % of said nonaqueous solvent in said aqueous slurry/nonaqueous solvent mixture is increased until said aqueous slurry/nonaqueous solvent mixture is substantially free of said aqueous slurry for the purpose of removing residual slurry form the substrate and polishing head at the same time (Koss, column 6, lines 2-12).

5. Claims 21-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Koos (US '980) in view of Muroyama et al. (US 6,126,514) and Kobayashi (US 5,985,045).

Koos teaches a method of planarizing a substrate by employing two separate chemical mechanical polishing (CMP) steps (column 1, lines 5-9). In step 42 (FIG. 3), a first CMP polishing solution is applied to the surface of a polishing pad to facilitate planarization of the surface 35 of substrate 12 (column 5, lines 55-59), which is followed by applying a dilution solution to the polishing pad to remove slurry of the first CMP step, and after applying the diluting solution, a second CMP solution is applied to the polishing pad to facilitate additional planarization of the substrate (Abstract). In a preferred embodiment, the first CMP mixture includes an acidic pH with alumina particles (which is the same as applicant's aqueous slurry containing an abrasive material), (column 5, lines 55-65).

Koos teaches a plurality of deliver tubes 23 (FIG. 2) could be provided for delivering one or a plurality of solutions to the surface of a polishing pad and further incorporate by reference a multiple deliver system as described by Sandhu et al. (US 5,540,810), (column 3, lines 24-37). Koos further teaches a second diluting solution that is applied to the polishing surface of polishing pad 16 for cleaning residual slurry (or the first CMP step) from the polishing surface of the polishing pad 16 (column 6, lines 1-5) and rotating wafer carrier 10 and the polishing table 18 continuously during the cleaning step, to enable removal of residual slurry from the substrate 12 and polishing head 27 at the same time (column 6, lines 8-10), which suggests the polishing slurry that is applied onto the polishing pad would also be disposed onto a semiconductor wafer. Koos also teaches a diluting solution is applied to the polishing surface of polishing pad 16 for clearing the residual slurry of a first CMP step (column 6, lines 1-5) as well as a second

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diluting solution, which comprises a solvent, such as, deionized or alternative solvents such as acetone or alcohol, (same as applicant's nonaqueous solvent), (column 8, lines 8-14). Hence, the aforementioned reads on,

A method of fabricating a semiconductor wafer, comprising:

(a) mixing an aqueous slurry containing an abrasive material and a nonaqueous solvent in a mixing unit so as to create a first volume of an aqueous slurry/nonaqueous solvent mixture with a first weight % of said nonaqueous solvent prior to being disposed onto said semiconductor wafer;

(b) disposing a volume of nonaqueous liquid including a non-aqueous solvent containing an abrasive material onto a semiconductor wafer;

(c) polishing the semiconductor wafer with a polishing pad using said first volume;

(e) disposing said second volume of said aqueous slurry/nonaqueous solvent mixture containing an abrasive material onto said semiconductor wafer; and

(f) polishing said semiconductor wafer using said second volume, **in claim 21.**

Koos differs in failing to disclose (d) mixing said aqueous slurry containing an abrasive material and a nonaqueous solvent in a mixing unit so as to create a first volume of an aqueous slurry/nonaqueous solvent mixture with a first weight % of said nonaqueous solvent prior to being disposed onto said semiconductor wafer, **in claim 21.**

Muroyama teaches a dispersion medium for abrasive grains, used for a polishing slurry, contains at least water and a ketone based solvent may be added to the medium

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in order to increase the solubility of the wherein an aqueous inorganic compound of fine particles are dispersed in a nonaqueous dispersed solvent and using the slurry for polishing (column 4, line 61-column 5, line 5) Muroyama also teaches the added amount of ketone based solvent may be in a range of 0.1 to 10 vol (column 5, lines 5-7).

Kobayashi teaches a chemical-mechanical polisher that includes a container 111 of concentrated polishing fluid and a container 112 of diluent, and the components in the containers are in-line mixed to form a polishing fluid (column 53, lines 11-35), which illustrates mixing a polishing slurry and a solvent are known.

Since Muroyama mixing an aqueous polishing slurry with a nonaqueous solvent is known and Kobayashi illustrates mixing a polishing slurry and a solvent in a unit is known, then it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Koos' slurry by employing a nonaqueous solvent as taught by Muroyama for the purpose of using polishing slurry that polishes a variety of films such as silicon oxide, a metal oxide, metal nitride, an organic compound, and a meal film containing at least fluorine, phosphorus, arsenic and born (Muroyama, column 5, lines 13-16). Further, modifying the combination of Koos and Muroyama by mixing a polishing slurry and a solvent as taught by Kobayashi would have been obvious to one having ordinary skill in the art at the time the invention was made for the purpose better controlling over polishing since mixing occurs near the point of use that allows the polishing rate to be relatively high and less time variable than batch mixing (Kobayashi, column 6, lines 1-4).

6. Claims 25 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Koos (US '980) in view of Tsuchiya et al. (US 5,733,177).

Koos differs in failing to teach reducing the pressure of said polishing pad, respectively on said semiconductor wafer and said front side of said semiconductor wafer prior to completing disposing a volume of nonaqueous liquid including a nonaqueous solvent onto said semiconductor wafer, **in claims 25 and 26**.

Tsuchiya teaches, "the applied pressure between the polishing pad and the wafer is simultaneously quickly decreased to reduce mechanical abrasion effects" (claim 8).

Tsuchiya illustrates reducing the pressure of a polishing pad on a semiconductor wafer is known. Hence, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Koos by using Tsuchiya's method of reducing the pressure of a polishing pad on a semiconductor wafer for the purpose of reducing abrasion effects (Tsuchiya, claim 8).

7. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Koos (US '980) in view of Tsuchiya (US '177) as applied to claim 25 above, in further in view of Merchant (US '830 B1).

Koos in view of Tsuhchiya differs in failing to teach said nonaqueous solvent includes an amine.

Koos differs in failing to teach said nonaqueous solvent includes an amine.

Merchant teaches, "The CMP slurry **10** includes a first emulsion **11** having a continuous aqueous phase (AQ_E) **12** and a second emulsion **13**. . . . The first emulsion **11** includes abrasive particles **18** . . . The second emulsion **13** preferably comprises an

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organic phase (ORG) **14** and a dispersed aqueous phase (AQ_i) **16** for capturing metal particles polished from the semiconductor wafer **20**" (column 3, lines 49-60). "The organic phase **14** may comprise alcohol or iso-alcohol and preferably includes at least one complexing agent such as, from example, . . . bi-pyridine (which is an example of a nonaqueous ammine) . . ." (column 4, lines 12-19).

It would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Koos in view of Tsuchiya by including a nonaqueous solvent such as an ammine that is taught by Merchant for the purpose of capturing metal particles polished from the semiconductor wafer (Merchant, column 3, lines 56-60).

8. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Koos (US '980) in view of Tsuchiya (US '177) as applied to claim 25 above, and further in view of Zhou et al. (US 5,780,358').

Koos in view of Tsuchiya differs in failing to teach said nonaqueous solvent includes dimethylsulfoxide (DMSO).

Zhou teaches "Preferably, the non-aqueous coordinating solvent with the Chemical-Mechanical Polishing (CMP) slurry composition of the present invention is chosen from the group of . . . (DMSO)" (column 8, lines 1-6). "In addition to the non-aqueous coordinating solvent, . . . the abrasive powder, various other components may optionally be included within the Chemical-Mechanical Polishing (CMP) slurry composition of the present invention. These components include but are not limited to . .

. aqueous and non-aqueous co-solvents . . . and the like as are know in the art to impart other desirable properties to the Chemical-Mechanical Polish (CMP) slurry composition of the present invention" (column 8, lines 40-49).

It would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Koos in view of Tsuchiya by including DMSO to a polishing slurry, as taught by Zhou for the purpose of assisting in rapid dissolution of copper metal under mild conditions (column 7, lines 51-55).

Allowable Subject Matter

9. Claims 9, 10, and 11 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

10. The following is a statement of reasons for the indication of allowable subject matter:

As to claims 9, 10, and 11, the prior art of record, taken either alone or in combination fails to teach or suggest obvious a method of polishing a semiconductor wafer with an aqueous slurry along with a nonaqueous solvent that includes either an N,N-propanalamide, aniline, and N,N-dimethylaniline.

Response to Arguments

11. Applicant's arguments filed 6/16/2006 have been fully considered but they are not persuasive. Applicant traverses the rejection of claim 13 under 35 § U.S.C. 103(a)

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over Koss et al. (US 5,934,980) in view of Merchant et al. Applicant argues the lack of motivation to combine Koss and Merchant as proposed by the Examiner (see Remarks, pages 10-11).

Applicant's arguments are acknowledged. However, Merchant's teaching of: "CMP slurry **10** includes a first emulsion **11** having a continuous aqueous phase (AQ_E) **12** and a second emulsion **13**. . . . The first emulsion **11** includes abrasive particles **18** . . . The second emulsion **13** preferably comprises an organic phase (ORG) **14** and a dispersed aqueous phase (AQ_I) **16** for capturing metal particles polished from the semiconductor wafer **20**" (column 3, lines 49-60). "The organic phase **14** may comprise alcohol or iso-alcohol and preferably includes at least one complexing agent such as, from example, . . . bi-pyridine (which is an example of a nonaqueous amine) . . ." (column 4, lines 12-19) is relied upon to cure Koss' deficiency, a nonaqueous solvent includes an amine.

In response to Applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, the reason for the combination of Koss in view of Merchant is for the purpose of capturing metal particles polished from the semiconductor wafer (Merchant, column 3, lines 56-60).

Applicant traverses the rejection of claims 25-26 under 35 § U.S.C. 103(a) over Koss (US '980) in view of Tsuchiya et al. (US 5,733,177). Applicant argue the rejection of claim 25 does not constitute a prima facie case of obviousness (See Remarks, pages 16-17) and nor is there a motivation or suggestion to modify Koss to include the pressure reducing step prior to completing disposing the volume of nonaqueous liquid on the wafer.

Applicant's argument is acknowledge but unpersuasive because Tsuchiya is relied upon to teach cure Koss' deficiency by teaching, "the applied pressure between the polishing pad and the wafer is simultaneously quickly decreased to reduce mechanical abrasion effects" (claim 8), which illustrates reducing the pressure of a polishing pad on a semiconductor wafer is known.

In response to Applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, the reason for the combination of Koss in view of Tsuchiya is for the purpose of reducing abrasion effects (see Tsuchiya, claim 8).

12. Applicant's arguments, see Remarks (pages 1-20), filed 6/16/2006, with respect to claims 6 and 21 have been fully considered and are persuasive. The rejection of

claims 6 and 21 and independent claims 22-24 has been withdrawn because the limitations or the claims were not fully addressed. Hence, a new Office Action was presented.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lynette T. Umez-Eronini whose telephone number is 571-272-1470. The examiner is normally unavailable on the First Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571-272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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September 1, 2006

NADINE NORTON
SUPERVISORY PATENT EXAMINER
ART UNIT 1765
